engineering laboratory

Systems Analysis Integration for Smart Manufacturing Operations

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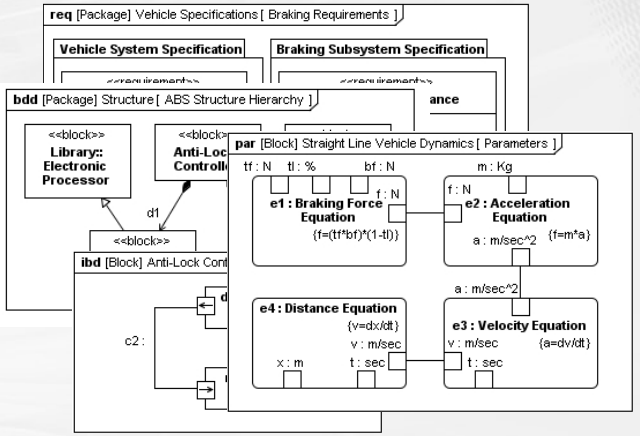
Engineering Analysis

- How do we know it will work when it's built?
- How will we figure out problems during operation?

Model-Based Systems Engineering

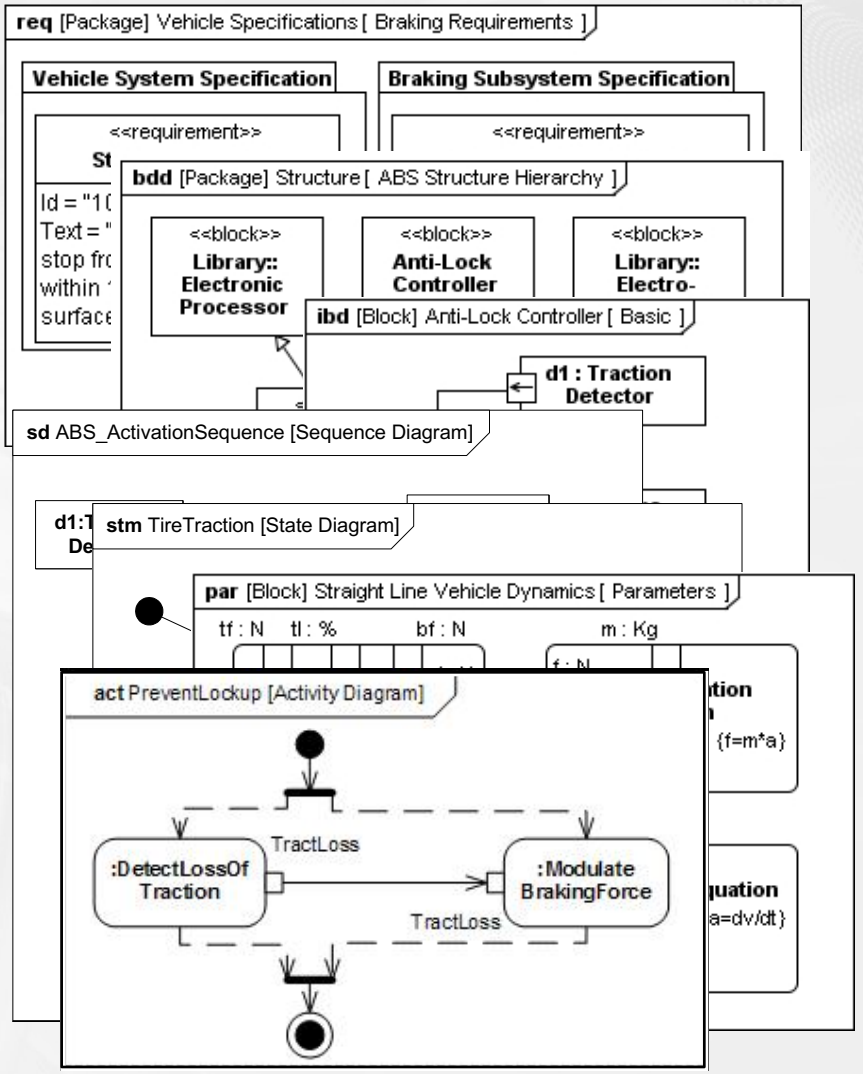


Paper **Electronic Documents** **Computerized Models**

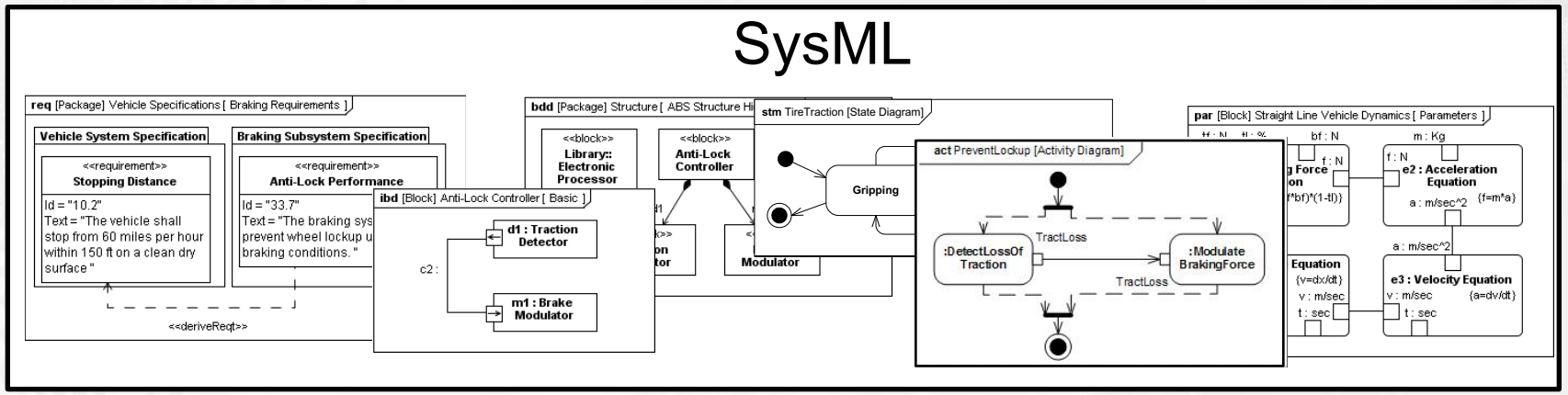
- Need computer-processable models of the systems being analyzed.

Systems Modeling Language (SysML)

- Most widely used graphical modeling language for systems engineering.
- International standard since 2007.
- Diagrams for:
  - Requirements, component breakdown and interconnection, behavior, parametrics.



Systems Analysis Integration



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Material languages

Hydraulic languages

Production languages

Simulation languages

Control languages

languages

- Overlapping and inconsistent system specifications in multiple languages.

Technical Approach

1. Select analysis areas to address.
2. Examine the literature and widely-used tools in those areas.
3. Develop information abstractions.
4. Identify overlap with SysML concepts.
   - Additional concepts for analyzing SE models.
5. Develop or choose integration technique.
6. Apply technique to SE/analysis gap.
7. Develop proof-of-concept.

Areas for Integration

1. Physical interaction / signal flow simulation.
2. Tradeoff analysis and optimization.
3. Finite element analysis.
4. Mathematical unification of systems and analysis models.
5. Production analysis (optimization & simulation).
6. Sustainability analysis.

Outputs

- All public domain.
- Standardization (see next).
- Journal and other papers.
- Proofs of concept (possibly open source).
- Presentations and demonstrations.

Standardization

- Involve industrial partners during technical work and standardization.
  - Engineering users and tool developers.
- Compare integration techniques used in technical work.
- Examine standards organizations for likely candidates.
  - Industrial involvement and timeliness.
- Begin standardization process.